United States General Accounting Office

GAO

Report to the Ranking Minority Member, Committee on Commerce, House of Representatives

September 1995

SUPERFUND

Operations and Maintenance Activities Will Require Billions of Dollars

GAO/RCED-95-259

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-262242

September 29, 1995

The Honorable John D. Dingell
Ranking Minority Member
Committee on Commerce
House of Representatives

Dear Mr. Dingell:

The Environmental Protection Agency (EPA) has constructed remedies designed to clean up 275 of the nearly 1,300 contaminated waste sites on its list of the most hazardous sites in the nation—the National Priorities List.[1] Even though construction has been completed at these hazardous waste sites, additional activities, known as operations and maintenance, may be necessary. These activities are meant to ensure that the remedy continues to operate effectively and that the cleanup continues to protect human health and the environment. Although the states, the parties responsible for the contamination, and the federal government pay the operations and maintenance costs, EPA is responsible for monitoring these activities at all sites.

Because of your concern over the long-term costs and responsibilities for operations and maintenance at Superfund sites, we reviewed these activities, focusing on the following issues: (1) the extent to which operations and maintenance activities are necessary at Superfund sites, (2) the costs to the federal government, states, and responsible parties to perform these activities now and in the future, and (3) EPA's actions to help ensure that the operations and maintenance activities continue to protect human health and the environment.

Results in Brief

The federal government, states, and responsible parties must perform some long-term operations and maintenance at almost two-thirds, or 173, of the 275 sites we reviewed that were formerly or are currently on the National Priorities List and where the cleanup remedy has been constructed.[2] These activities—which include controlling the erosion of landfill covers, treating contaminated groundwater, or implementing and

[1]The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, authorized the creation of a "Superfund" to pay for the cleanup of contaminated sites. The term Superfund is also used to refer to the program for cleaning up these sites.

[2]Information on these 275 sites was available to us in May 1995. EPA may have completed the construction of cleanup remedies at additional sites since then.

enforcing restrictions on the use of land or water on or adjacent to the sites—will continue for decades and, in some cases, indefinitely.

For cleanup remedies that EPA or the responsible parties have already undertaken or will undertake from now to fiscal year 2005, we estimate that about $32 billion[3] will be needed for operations and maintenance costs nationwide through fiscal year 2040. The states and responsible parties will bear most of these costs. We estimate that the costs to the federal government, states, and responsible parties will be $5 billion, $8 billion, and $18 billion,[4] respectively. The expenditures necessary for a given cleanup remedy are largely determined by the type of remedy EPA selects. For example, sites whose cleanup plan requires that waste be contained or that contaminated groundwater be treated both need operations and maintenance, but the operations and maintenance cost for containment is about a third of that for treating groundwater.

Although EPA monitors operations and maintenance activities at all sites, the agency's principal focus until recently has been on evaluating and cleaning up the sites. Monitoring is important because the states and responsible parties do not always follow their operations and maintenance plans and because conditions at the sites can worsen, requiring further cleanup action. At least every 5 years, EPA is required to review conditions at many sites that need operations and maintenance, and these reviews have often revealed potential and actual problems that the states or responsible parties have had to correct. However, the agency has a significant backlog of overdue reviews and consequently may be unaware of deteriorating conditions at some sites.

Background

Under Superfund, the federal government can pay for site cleanups or may require the responsible parties to pay for and perform them. Often the construction of cleanup remedies will also require subsequent operations and maintenance (O&M) activities to ensure that the remedy continues to protect human health and the environment. The costs of O&M are borne by the federal government, states, and responsible parties. When the federal

[3]All dollar figures in this report are in 1994 dollars, unless otherwise noted. We provided preliminary estimates in testimony before the Subcommittee on Commerce, Trade, and Hazardous Materials, House Committee on Commerce: See Superfund: Information on Operations and Maintenance Activities and Costs (GAO/T-RCED-95-201, May 24, 1995). The projections provided in this report differ slightly from the estimates in the testimony statement.

[4]These figures do not add to $32 billion because we excluded cleanups jointly funded by the federal government and responsible parties. We forecast that operations and maintenance activities for these cleanups will cost $700 million.

government pays for the cleanup, EPA's regulations require that the states pay for most of the O&M activities. If groundwater treatment is necessary at these sites, the federal government pays 90 percent of the O&M costs for the first 10 years of such treatment and the states pay the remaining costs.[5] At sites where no groundwater treatment is needed, EPA turns the responsibility for O&M over to the state after ensuring that the remedy is working properly. The federal government also pays for O&M activities at federal facilities that have sites on their property on the National Priorities List (NPL). When the responsible parties clean up a site, they also pay the costs of O&M activities.

EPA monitors conditions and O&M activities at all these sites to determine if the sites' O&M plan is being followed. At those sites that currently can be used only in a limited way because waste remains in the soil or groundwater, EPA's site project managers are also required to conduct a formal review of conditions at least every 5 years—known as a "5-year review."

When Superfund was reauthorized in 1986, it called for EPA to prefer treating the waste in the highly contaminated areas of a site over containing such waste because treatment was considered to be a permanent remedy. For example, in areas where soil is highly contaminated, EPA is to prefer treating the soil (by, for example, solidifying it to immobilize contaminants or applying a vacuum system to remove contaminants) instead of containing the soil (by, for example, installing a waterproof cover over it). Nevertheless, EPA sometimes selects containment for less-contaminated areas or for waste that cannot be treated successfully or cost-effectively—for example, large volumes of landfill waste. At sites where groundwater is an actual or potential source of drinking water, the law requires that the groundwater be treated until it reaches the standards established in the Safe Drinking Water Act.

[5]For funding purposes, CERCLA classifies activities during this 10-year period as part of the cleanup, not as O&M. However, since activities during this period are in fact O&M activities, we classified their costs as O&M costs in our projections.

Long-Term O&M Activities Are Required at a Majority of These Sites

Almost two-thirds, or 173, of the 275 sites we reviewed where the cleanup remedy is in place[6] will require long-term O&M activities to ensure that the cleanup remedy continues to protect human health and the environment. Specifically, we found the following:

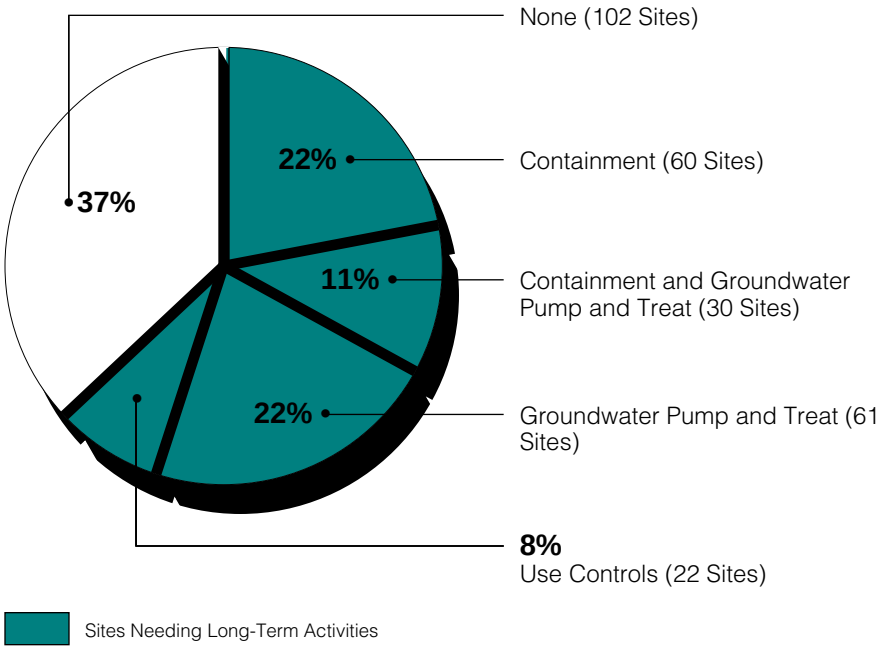
- 60 of the sites use waterproof covers of clay or other materials to physically contain hazardous waste or contaminated soil. These covers prevent exposure to the waste and reduce the level of contaminants entering the groundwater. At these sites, maintenance—such as erosion control and periodic inspections—is required for an indefinite period. (See app. I for more details on O&M activities at specific sites.)
- 61 of the sites pump and, in some cases, treat groundwater as the primary cleanup remedy. At these sites, pumps and treatment systems will need to be operated and maintained, the equipment kept in repair, and the groundwater's quality monitored until the cleanup standards are reached.
- 30 of the sites use both waste containment and groundwater treatment technologies in combination to address surface and groundwater contamination. At these sites, erosion control, inspections, operation of pumps and treatment systems, and groundwater monitoring will be required.
- 22 of the sites require local governments or landowners to restrict land or water use on or near the site to protect the cleanup remedy or to prevent the public from being exposed to hazardous waste.[7] Such controls include closing drinking water wells, prohibiting the drilling of new wells, and/or imposing restrictions on deeds.
- 102 of the sites require little or no O&M because EPA decided no cleanup was needed or selected a remedy that required no O&M, such as treating surface waste.

Figure 1 shows the distribution of the O&M activities that will be required at the 275 sites.

[6]EPA refers to these sites as "construction-complete" when the selected cleanup remedy has been built. The classification does not necessarily mean that all hazardous waste has been removed from the site, particularly if waste has been contained or if waste or groundwater treatment is ongoing. See GAO/RCED-93-188 for additional information on construction-complete sites.

[7]Thirty-six of the 151 sites where the remedy included containment or groundwater pumping also required restrictions on land or water use.

Figure 1: O&M Activities Required at the 275 Superfund Sites



Notes: Containment requires protecting an area with a waterproof cover (cap). The cap must be routinely monitored.

Groundwater "pump and treat" requires extracting water through pumps and treating the water to reduce contaminants.

Use controls require monitoring and controlling local land or water use through fencing and/or deed or other restrictions.

Sites using containment and/or groundwater pump and treat may also require use controls.

The percentages used in this figure reflect information on the sites as of May 1995.

Future O&M Costs to EPA, States, and Responsible Parties

We estimate that the federal government, states, and responsible parties will spend $32 billion for O&M costs over the next four decades; EPA estimated that they will spend $37 billion over this period.[8] The states and responsible parties will bear most of these costs. (See app. II for information on how these estimates were developed.)

[8]Our estimate of the total O&M costs is lower than EPA's because we (1) used a consistent discount rate of 6 percent to better represent the actual discount rates used by EPA's project managers to estimate present-value figures; (2) excluded costs from some cleanup plans that EPA inadvertently classified as O&M costs; and (3) calculated and used a different, lower average O&M cost per cleanup plan than EPA used.

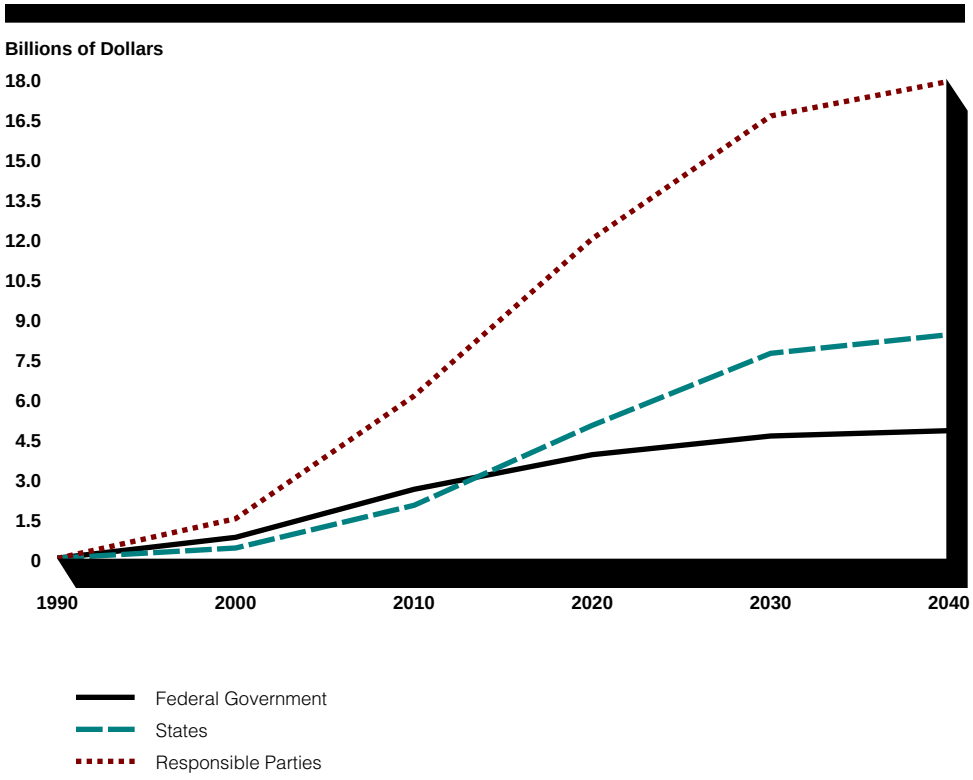
O&M Costs Will Total Billions

On the basis of our analysis of EPA's O&M database, we estimate that $32 billion will be required for the O&M activities associated with the cleanup plans already approved or projected to be approved through fiscal year (FY) 2005.[9] The sites that have already been placed on the NPL represent $25 billion, or 78 percent of that total, and the sites that will be added to the list during FY 1995 or later represent an additional $7 billion. (See app. II for a comparison of EPA's and our methodologies for estimating future O&M costs.)

While the annual O&M costs were estimated at $148 million in FY 1994, these costs will increase over time. We estimate that the annual costs to the federal government, states, and responsible parties will peak at $1 billion in FY 2010. This figure reflects (1) the substantial increase in completed cleanups requiring O&M that EPA projects by the end of the century and (2) the fact that O&M is typically expected to last at least 30 years. We expect that federal costs will become relatively level over the next few decades because EPA has to pay for O&M only at the sites where groundwater is being treated, and only for 10 years. However, the states' costs will continue to increase as EPA turns these sites over to the states, which must continue to perform O&M activities for 20 years or more. Figure 2 shows the cumulative costs to all parties for the cleanup plans already approved or projected for approval through FY 2005.

[9]To make these and subsequent estimates, we analyzed an EPA database that includes estimates of O&M costs from 1,105 record of decision (ROD) documents. These RODs contain EPA's official plan for cleaning up all or a portion of the waste at a site on the NPL. We refer to RODs as cleanup plans throughout this report. EPA estimates that the average site requires two RODs.

Figure 2: Cumulative O&M Costs to the Federal Government, States, and Responsible Parties



Notes: We estimate that the O&M costs to the federal government, states, and responsible parties will be $4.8, $8.4, and $17.9 billion, respectively. We excluded from this analysis cleanups jointly funded by the federal government and responsible parties. We forecast that the O&M costs for these cleanups will total $700 million.

These projections are based on the site cleanup plans signed during fiscal years 1982 through 2005. If additional Superfund cleanups are planned after that period, the total O&M costs will also increase.

Whether the states will be able to meet these future O&M obligations is not clear. In a recent report,[10] we found that the states, because of their resource constraints, are already having difficulty in meeting federal environmental requirements in two water programs and in overseeing facilities handling hazardous waste. Only five of the Superfund program

[10]EPA and the States: Environmental Challenges Require a Better Working Relationship (GAO/RCED-95-64, Apr. 3, 1995).

managers we interviewed from eight states said they had done any forecasting to determine their future O&M costs.

Type of Cleanup Determines O&M Costs

The federal government, states, and responsible parties can expect to pay an average of $12 million over 30 years for the O&M associated with a single cleanup plan. These costs vary according to the type of activities required. For example, we found the following:

- When the cleanup remedy uses a technology designed to contain surface waste, the ongoing O&M activities after the containment system is built could typically cost $5 million over 30 years.
- When the cleanup remedy includes treating groundwater, operating and maintaining the treatment plant and water pumps after construction could typically cost $17 million over 30 years.
- When the cleanup remedy calls for treating surface waste or contaminated soil, additional O&M activities are not required.

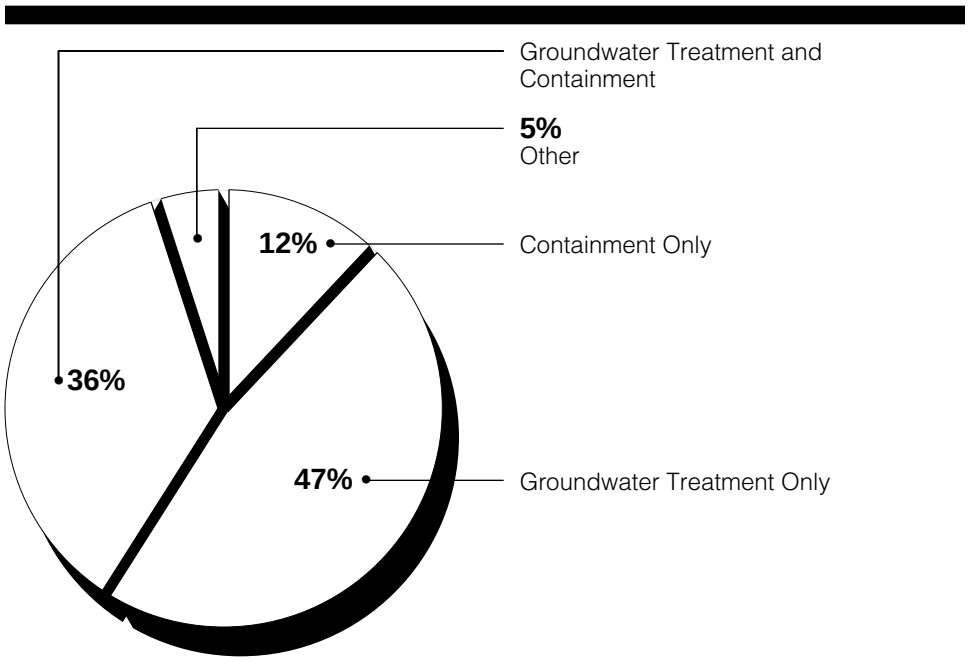
The actual O&M costs may eventually be greater than these estimates. When developing estimates of O&M costs, EPA generally assumes that O&M activities will be required for 30 years. However, EPA recently surveyed its regional project managers and found that about 20 percent of cleanups will require O&M for more than 30 years. For example, the sites where waste is contained require O&M activities—to inspect and repair the cover—indefinitely. Furthermore, because these containment remedies have been in place for less than 10 years, the long-term repair costs are not yet known. Groundwater treatment generally continues until the cleanup standards are met, but EPA recently concluded that many groundwater treatment systems are not as efficient as was originally hoped. As a result, more than 30 years may be required to reach cleanup goals, primarily because of contaminants in groundwater that are heavier than water[11] and thus very difficult to extract. EPA estimates that these contaminants may be present at about 60 percent of the sites where the groundwater is contaminated.

O&M for groundwater treatment constitutes the majority of the costs that the federal government, states, and responsible parties face. We estimate that the O&M costs for cleanups that only treat groundwater represent about 47 percent of the anticipated costs. Furthermore, we estimate that the O&M costs for cleanups that combine treating groundwater with

[11]These contaminants, known as dense nonaqueous phase liquids (DNAPLs), are difficult to locate and extract through standard methods for pumping groundwater. DNAPLs release contaminants into the groundwater over long periods.

containing waste represent about 36 percent of all O&M costs. For cleanup remedies in which surface waste is contained but groundwater is not treated, the O&M costs constitute about 12 percent of the costs that the federal government, states, and responsible parties will face. Figure 3 illustrates the share of the O&M costs each party will be expected to pay.

Figure 3: Percentage of O&M Costs Associated With Groundwater Treatment and Waste Containment Remedies



Note: This analysis is based on the cleanup plans approved during FY 1988 through 1991 because we had specific information on the remedies selected in these plans.

Changes in EPA's policy or in the Superfund law, particularly in the guidelines for selecting cleanup remedies, could alter future O&M costs for the federal government, states, and responsible parties. For example, in recent discussions about reauthorizing the Superfund legislation, it has been suggested that the current preference for treating rather than containing surface waste might be changed to a preference for containing waste. Such a change would most likely lead to increased O&M costs because O&M activities would be required at a higher percentage of sites

than is currently the case. (See app. II for information on how other potential policy changes could affect responsibilities for O&M.)

EPA's Monitoring Activities Have Been Limited

EPA is responsible for monitoring O&M to ensure that these activities are performed as planned and that the cleanups continue to protect human health and the environment. However, until recently, the agency has focused on getting sites evaluated and cleaned up rather than on monitoring those sites where the cleanup remedy is in place. EPA is responsible for two types of monitoring: (1) reviewing actions that the states and responsible parties have taken to comply with the sites' O&M plan and (2) evaluating, at least every 5 years, the condition of certain sites where waste remains on-site. Although O&M has been ongoing at some sites for several years, EPA is just now developing guidance to monitor how the states and responsible parties perform O&M activities. In addition, EPA is significantly behind in performing its 5-year reviews.

O&M Monitoring

We reviewed O&M activities at 57 sites: 43 sites at which 5-year reviews had been performed (including 3 sites for which we conducted case studies) and an additional 14 sites for which we also conducted case studies. For 11 sites, we found that EPA had not been closely monitoring whether the states and responsible parties were following their required action plans for O&M. At these sites, the plan was not being followed; at some sites, conditions had deteriorated after the cleanup was completed. For example, the states or responsible parties were not maintaining the waterproof covers over contaminated soil, were allowing trees and brush to grow and potentially damage the covers, and were not performing the groundwater sampling called for in the plan. (See app. III for additional examples of EPA's monitoring of O&M activities.)

We also found a site at which EPA's monitoring helped to prevent deterioration of the cleanup. At the Lehigh Electric site in Old Forge, Pennsylvania, EPA had removed all surface debris, equipment, and soil contaminated with PCBs.[12] Consequently, in 1986 the site was deleted from the NPL. However, ongoing groundwater monitoring revealed that PCB contamination levels were increasing. Consequently, EPA has recommended a new study to determine the source of contamination and possible cleanup methods.

[12]PCBs are polychlorinated biphenyls—organic chemicals that are carcinogenic.

EPA currently has no guidance for site project managers on monitoring O&M, but the agency plans to issue a new directive in December 1995. Without guidance on the day-to-day monitoring of O&M activities, EPA's project managers may not be able to adequately monitor the states and responsible parties. More importantly, without guidance these project managers cannot ensure that the cleanups continue to protect human health and the environment.

Five-Year Reviews

EPA must also complete more formal reviews at some sites at least every 5 years. The 1986 Superfund reauthorization called for these 5-year reviews to occur at certain future sites where waste remaining after the cleanup prevented unlimited access to or use of the site. Subsequently, EPA decided to also conduct these reviews at certain sites where the remedies were selected before 1986 and at sites where more than 5 years will be required to reach the cleanup goals. As noted above, these reviews are important in that they often identify when O&M activities are being neglected or conditions at the site are deteriorating. Thus, these reviews are needed to ensure that the remedy continues to protect human health and the environment.

For example, the 5-year review conducted at the Kellogg-Deering Wellfield Superfund site in Norwalk, Connecticut, identified problems with groundwater sampling. The site's responsible party was not sampling the groundwater, as required, at some wells used for monitoring. EPA's purpose in requiring the groundwater sampling was to provide an "early warning system" to detect the migration of contaminants. As part of ongoing work at other areas of the site, EPA has now approved a sampling plan that will monitor the cleanup's effectiveness.

In another example, a 5-year review identified problems at the Mowbray Engineering site in Greenville, Alabama. No maintenance had ever been performed at the site, and trees were growing on the landfill cover that had been placed over the contaminated soil.

Despite the benefits of the 5-year reviews, EPA's Inspector General found that EPA has a significant backlog of such reviews.[13] EPA officials told us that 66 reviews had been completed as of August 31, 1995, and that an additional 84 are due by September 30, 1995. The officials expect that most of these unfinished reviews will not meet the deadline. As a result of this

[13]Backlog Warrants Higher Priority for Five-Year Reviews, EPA, Office of Inspector General (Mar. 24, 1995).

backlog, the agency may not be aware of problems that may be occurring at other Superfund sites.

EPA is trying to reduce the size of the backlog by verifying which sites need a review and when it is due. The agency has also decided to narrow the scope of the review at those sites where the cleanup remedy is not fully in place. EPA's Inspector General concluded that adding 5-year reviews to the tasks for which regions have assigned annual targets could give the regions an incentive to improve performance. To address these concerns, the Assistant Administrator for Solid Waste and Emergency Response is taking measures to set more specific deadlines for 5-year reviews and to establish accountability for completing them.

Conclusions

The majority of sites in the Superfund program will require long-term operations and maintenance, especially those sites requiring waste containment or groundwater treatment. These operations and maintenance costs will constitute a substantial portion of the funds the federal government, states, and responsible parties spend to clean up the environment even after they have paid millions of dollars to construct the required cleanup remedy. Because operations and maintenance costs largely depend on the remedies selected for Superfund sites, the level of these costs will be strongly influenced by policy decisions, such as whether the cleanup remedies emphasize treatment or containment. Although some state officials told us that they expected operations and maintenance to become a considerable burden in the coming decades, most state officials we interviewed had not attempted to forecast the actual amount of these costs.

Oversight of operations and maintenance has been given a lower priority than other Superfund activities that EPA must implement and monitor. As a result, the states and responsible parties have not always performed the operations and maintenance activities required.

The guidance that EPA intends to develop on how to oversee operations and maintenance activities should help to remedy this situation. Because EPA has responded to the Inspector General's findings on 5-year reviews by developing plans to track the reviews more closely and establish accountability for completing them in a timely manner, we are not making any recommendations in this report.

Agency Comments

We provided copies of a draft of this report to EPA for its review and comment. On August 30, 1995, we met with officials from EPA's Office of Emergency and Remedial Response—the office charged with implementing the Superfund program—to obtain the agency's comments. These officials included, among others, the Acting Deputy Director of the Hazardous Site Control Division—the division responsible for policy on operations and maintenance. These officials told us they agreed with the facts and findings in the report and were pleased with its objectivity and accuracy. They also suggested a number of technical corrections, which we have incorporated in the report.

Scope and Methodology

To determine the extent of O&M required at Superfund sites, we reviewed information about the 275 sites where the cleanup remedy has been built and determined whether the sites would require O&M. To project future O&M costs to the federal government, states, and responsible parties, we used and modified an EPA database of estimates of the O&M costs associated with individual cleanup plans. We obtained this database from EPA's Office of Emergency and Remedial Response. We combined data from this database with information in a database that we had previously developed on cleanup remedies in order to determine the O&M costs associated with different types of cleanups. In addition, we conducted case studies at 17 sites to determine the actual O&M activities and costs at these sites. We also interviewed state Superfund program managers and EPA site cleanup managers for information on O&M activities and expenditures at the sites and on the states' financial capacity to fund O&M.

We reviewed EPA's draft guidance on O&M and the agency's guidance on 5-year reviews; we also used information from an evaluation of 5-year reviews by EPA's Inspector General. We interviewed EPA headquarters and regional managers about EPA's policy, guidance, and progress on 5-year reviews. We also reviewed and evaluated 43 reports on 5-year reviews that had been completed through March 1995. We conducted our work between August 1994 and September 1995 in accordance with generally accepted government auditing standards.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Administrator of EPA. We will also make copies available to others on request.

Please call me at (202) 512-6112 if you or your staff have any questions about this report. Major contributors are listed in appendix IV.

Sincerely yours,

Peter F. Guerrero
Director, Environmental
Protection Issues

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Abbreviations

EPA	Environmental Protection Agency
GAO	General Accounting Office
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DNAPL	dense nonaqueous phase liquid
FY	fiscal year
NPL	National Priorities List
O&M	operations and maintenance
PCB	polychlorinated biphenyl
ROD	record of decision

Results of Case Studies

We conducted case studies of hazardous waste sites in order to acquire information on actual experiences with and costs for operations and maintenance (O&M). We found 17 sites where the remedy had been built and that met the following criteria:

- The cleanup was funded by the federal government;
- the Environmental Protection Agency (EPA) had constructed either a groundwater pump and treat remedy or a waste containment remedy, thus requiring O&M; and
- EPA had completed construction of the cleanup at least 2 years before we began this work.

Table I.1 summarizes information for each of the 17 sites, including the location, type of remedy, and estimated and actual costs incurred by EPA and the states for O&M at each site.

Table I.1: Information on O&M Costs at 17 Sites

Site	EPA region	Type of remedy: Groundwater treatment	Type of remedy: Containment	Cleanup plan's annual O&M estimate[a]	Total O&M costs incurred by EPA[b] to date	O&M costs incurred by states[c]
Bruin Lagoon, PA	III		•	$21,920	$282,229 over 2 months	$183,787 over 2 years and 3 months
Lehigh Electric, PA	III		•	$70,840	$15,540 over 2 years and 6 months	$117,594 over 9 years
A.L. Taylor, KY	IV		•	Not available	$111,026 over 1 year and 3 months	$8,658 over 1 year and 2 months
Distler Farm, KY	IV	•		$155,632	$1,312,832 over 3 years	Not available
Independent Nail, SC	IV		•	$29,475	$17,719 over 3 months	$58,849 over 4 years and 6 months
Lees Lane Landfill, KY	IV		•	$174,593	$88,294 over 1 year	0[d]
Mowbray, AL	IV		•	0	$5,422 over 13 months	Not available
Newport Dump, KY	IV		•	$82,530	$409,450[d] over 3 years	0[d]
SCRDI Dixiana, SC	IV	•		$97,183	$528,226 over 2 years	$251,432 over 2 years
Eau Claire Municipal Wellfield, WI	V	•		$276,900	$411,342[d] over 6 years	Not applicable[e]

(continued)

Site	EPA region	Type of remedy: Groundwater treatment	Type of remedy: Containment	Cleanup plan's annual O&M estimate[a]	Total O&M costs incurred by EPA[b] to date	O&M costs incurred by states[c]
Old Mill, OH	V	•		$63,900	$1,500,601 over 5 years	Not applicable[e]
Tri-State Plating, IN	V	•		Not available	$28,453[d] over 1 year and 3 months	Not applicable[e]
Arkansas City Dump, KS	VII		•	$3,780	$44,240 over 1 year	$400 over 9 months
Del Norte Pesticide, CA	IX	•		0	$286,000[f] over 2 years	Not available
Mountain View Mobile Homes, AZ	IX		•	0	$1,073 over 1 year	Not available
Silver Mountain Mine, WA	X		•	$46,390	$4,620 over 2 years	Not applicable[e]
United Chrome Products, OR	X	•		$357,570	$131,000[d] over 6 years and 3 months	0[d]

[a]Represents annual O&M estimate converted to 1994 dollars.

[b]These estimates were adjusted to 1994 dollars. Where we did not have information on annual expenditures, we assumed that the costs were distributed evenly over the period in which the costs were incurred. Costs are as of October or December 1994.

[c]EPA assumes responsibility for the first 10 years of O&M at sites where groundwater is treated. The states are responsible for O&M after the first 10 years. Thus, the data given for the states' costs are not final.

[d]The responsible parties have agreed to pay for O&M. If EPA has incurred costs, the responsible parties have reimbursed or will reimburse those costs.

[e]Not applicable means that EPA has not yet turned the site over to the state or responsible parties.

[f]Project manager's estimate

Source: Information on actual costs provided by EPA and state officials.

Estimating Future O&M Costs

EPA used estimates of O&M costs, developed as part of each cleanup plan, to forecast the total O&M costs as well as the states' share of these costs for all current and anticipated Superfund sites. For sites expected to be listed on the National Priorities List (NPL) through fiscal year (FY) 2005, EPA estimated that the total O&M costs will be $37.3 billion and that the states will pay $11.9 billion of this total.[14] In developing these estimates, however, EPA did not separately forecast the O&M costs that the federal government and responsible parties will be expected to pay. In addition, the estimate of average O&M costs that EPA used to forecast O&M costs did not distinguish among the types of cleanups. These costs can vary widely depending on the type of cleanup selected.

We obtained EPA's database of the O&M estimates to make additional cost projections, including (1) the O&M costs that the federal government will be expected to pay, (2) the O&M costs that the responsible parties will be expected to pay, (3) the average O&M costs for those sites with and without groundwater contamination, and (4) the proportions of the total forecast O&M costs that are for current Superfund sites and sites EPA anticipates adding to the NPL in the future.

We estimated that the total O&M costs for cleanup plans expected to be signed through FY 2005 will be $32 billion, with the federal government, states, and responsible parties paying about $5, $8, and $18 billion, respectively.[15] Our estimate of total O&M costs is lower than EPA's estimate because we (1) used a consistent discount rate of 6 percent to better represent the actual discount rates used by EPA's project managers to estimate present-value figures, (2) removed costs in some cleanup plans that EPA inadvertently classified as O&M costs, and (3) calculated and used a different, lower average O&M cost—$337,000 per year—for each cleanup plan as opposed to the average cost of $434,000 per year calculated by EPA. This different average annual cost resulted both from decreased O&M costs for some cleanup plans because of the lower discount rate we used and from our inclusion of cleanup plans which involved no O&M costs when calculating the average.

[14]Estimated O&M Costs for RODs: Historical Trends and Projected Costs Through FY 2040, prepared for EPA by CH2M Hill (May 31, 1995). The O&M cost estimates are reported in 1994 dollars.

[15]These figures do not add to $32 billion because some cleanups were jointly funded by the federal government and responsible parties. We estimate that the O&M costs for these cleanups will total about $700 million.

EPA's Approach and Assumptions

For its analysis, EPA began with the O&M estimates for the sites with cleanup plans signed during FY 1982 through 1992. To project future O&M costs for the cleanup plans it signed during FY 1993 and 1994, in addition to those it anticipates signing during FY 1995 through 2005, EPA used an average O&M estimate of $434,000 per year for each cleanup plan.[16] On the basis of historical data, EPA anticipates preparing 175 cleanup plans per year.

The 1,105 cleanup plans signed during FY 1982 through 1992 reported O&M estimates as either present-value figures[17] or annual figures. To use the estimates reported in present-value figures in its analysis, EPA annualized the estimates using a 10-percent discount rate[18] in order to calculate the total O&M costs over the duration of the cleanup. Unless the cleanup plan specified otherwise, EPA assumed the O&M activities would continue for 30 years. EPA also assumed a 5-year lag between the time the cleanup plan was signed and the start of the O&M activities, unless actual data were available. To allow for comparison, EPA converted all dollar figures to 1994 dollars, using a uniform 4-percent annual rate of inflation.

To estimate the states' share of future O&M costs, EPA categorized the cleanup plans as either non-groundwater or groundwater cleanups. For EPA-funded cleanups not including groundwater contamination, EPA assumed that the states pay 100 percent of the O&M costs over the entire cleanup period. In the absence of specific data, for the EPA-funded cleanups including groundwater contamination, EPA assumed that contaminated soil or other surface waste was also being cleaned up. EPA then assumed that the O&M costs would be split evenly—50 percent to address groundwater contamination and 50 percent to address the other contamination. Consequently, during the first 10 years of the cleanup, EPA assumed that the states will pay 50 percent of the O&M costs for the surface

[16]EPA did not use the cleanup plans signed from FY 1982 through 1986 in developing the estimate of average O&M costs. These cleanup plans were prepared before passage of the Superfund amendment, which occurred in October 1986. That amendment substantially affected responsibilities for O&M costs. For instance, it placed an increased emphasis on treating rather than containing waste, thus decreasing the total O&M costs. In addition, EPA subsequently increased its efforts to identify responsible parties to clean up the waste at Superfund sites, which consequently increased the responsible parties' O&M costs.

[17]When selecting a cleanup remedy, EPA chooses between several alternatives. In certain cases, EPA calculates the cost of a remedy at its present value; in other cases, it uses different methods. Such calculations are necessary to compare a stream of expenditures, such as O&M costs over several decades, with expenditures for a different alternative and time frame.

[18]The discount rate is a percentage adjustment used in calculating present value. It adjusts cost estimates for (1) inflation and (2) the time value of money. The discount rate may be viewed as the rate of return on the best alternative investment opportunity for the funds, or the cost of borrowing the funds.

waste and the federal government will pay the remaining 50 percent of the O&M costs for pumping and treating groundwater. For the remaining 20 years, the state will pay 100 percent of all the O&M costs for these sites.

GAO's Approach and Assumptions

To begin our analysis, we performed quality assurance checks to ensure that the estimates of O&M costs in EPA's database were valid and reliable. We checked a random sample of cases to see whether the estimates of these costs in the cleanup plans were recorded accurately in the database and were properly adjusted to 1994 dollars. We also checked whether cleanup plans were properly categorized as involving groundwater contamination or not. We did not find any significant discrepancies. Because we were concerned about whether the estimates in the cleanup plans were a good indicator of actual O&M costs, we compared the estimates for the 17 sites for which we performed case studies with the actual O&M costs incurred. Some costs were higher or lower than the estimates, but we did not detect any bias in one direction or the other that would affect the use of these estimates to forecast future costs. (See app. I for additional information on our case studies.)

When making these checks, we learned that EPA had used a 10-percent discount rate to adjust those estimates that were reported in present-value form. However, most EPA managers had originally estimated these values using a 5-percent discount rate, as prescribed by EPA guidance issued in October 1988, although some managers used other rates. EPA's use of a 10-percent discount rate to annualize these values thus resulted in an overstatement of the original estimates of O&M costs in the cleanup plans. EPA used this 10-percent rate following the guidelines recommended by the Office of Management and Budget. For our estimates of annual O&M costs, we used a 6-percent rate to better represent the rates actually used by all EPA project managers.[19]

For a small number of cleanup plans signed during FY 1988 through 1991, we decided to adjust the estimates of O&M costs. In particular, we determined that for these plans, EPA's projections of O&M costs included the costs of treating surface waste. According to EPA officials, such costs are not O&M costs but rather cleanup costs. Therefore, we revised the estimates for some of these cleanup plans to reflect this correction.

In order to conduct our analysis, we developed a model for estimating O&M costs that considered (1) when cleanup plans were signed, (2) who will

[19]We were unable to determine which cleanup plans signed in FY 1989 used present-value estimates.

pay O&M costs—the federal government, states, or responsible parties, (3) what type of remedy was used (groundwater treatment or not), and (4) whether the costs are for current or future NPL sites. Our model projected future O&M costs for cleanup plans signed during FY 1993 through 2005 on the basis of plans signed after Superfund amendments passed in October 1986 because the changes affected responsibilities for O&M costs. We also assumed that 45 new sites will be added to the NPL each year beginning in FY 1995. We based our assumptions about who will pay O&M costs on Superfund regulations, extensive conversations with EPA officials, and our analysis of O&M costs at specific types of sites.

Estimating Federal Costs

In our model, we assumed that the federal government's O&M costs consist of (1) all O&M costs at federal facilities and (2) the federal portion of O&M costs for the cleanup plans at sites where EPA funds the cleanup and the remedy addresses groundwater contamination. To estimate these latter costs, we took the following steps, using 650 cleanup plans signed during FY 1988 through 1991 and their estimated O&M costs for the first 10 years:

- First, we estimated the groundwater treatment portion of O&M costs for cleanups addressing both groundwater contamination and surface waste. We estimated this portion to be 75 percent. We arrived at this figure by dividing the average O&M cost for the 220 cleanup plans that address only groundwater contamination by the sum of this average and the average O&M cost for the 168 cleanup plans that involved only containment of surface waste.
- Second, we estimated the ratio of the groundwater treatment portion of O&M costs to the total O&M costs for all 360 cleanup plans involving groundwater treatment, whether alone or in combination with surface waste containment. We determined this ratio to be 89 percent. As described above, for cleanup plans involving both groundwater treatment and surface waste containment, we assumed that 75 percent of the O&M costs are due to the groundwater treatment. For plans addressing only groundwater contamination, we assumed that 100 percent of the O&M costs are due to groundwater treatment.
- Finally, we estimated the federal portion of O&M costs for cleanup plans involving groundwater treatment. By statute, the federal government pays 90 percent of the total O&M costs during the first 10 years of such cleanups. Therefore, we multiplied this 90 percent by 89 percent, our estimate of the share of O&M costs represented by groundwater treatment, as described above. This calculation resulted in our assumption that the federal portion of O&M costs for EPA-funded cleanups is 80 percent for the first 10 years of

cleanups involving groundwater treatment. This differs from EPA's assumption that the federal portion is 50 percent because EPA did not go through such steps to more specifically estimate groundwater-related O&M costs.

Table II.1 shows where GAO's and EPA's assumptions differ on the portion of O&M costs that will be paid by the federal and state governments.

Table II.1: Share of O&M Costs at EPA-Funded Cleanups Under GAO's and EPA's Assumptions

	First 10 years		Last 20 years	
Type of cleanup	Federal share	State share	Federal share	State share
Includes groundwater treatment	80% (GAO)	20% (GAO)	None	100%
	50% (EPA)	50% (EPA)	None	100%
Does not include groundwater treatment	None	100%	None	100%

Estimating States' Costs

We assumed that the states will pay 100 percent of the O&M costs for cleanups addressing surface waste that were originally funded by EPA. For EPA-funded cleanups that include groundwater treatment, the states are assumed to pay the remainder of O&M costs that the federal government does not cover. As noted above, we estimated that the federal portion of these cleanups is 80 percent; thus, the states are responsible for the remaining 20 percent of costs for the first 10 years. After the 10th year of O&M activities, we assume that the state pays 100 percent of O&M costs.

Estimating Responsible Parties' Costs

We identified all the O&M costs associated with responsible parties' cleanups to estimate their O&M costs. We excluded the O&M costs for cleanups performed jointly by EPA and the responsible parties from estimates of the costs to the federal government, states, and responsible parties since these costs were a small portion of the total O&M costs.

GAO's O&M Cost Projections

Our analysis of the total O&M costs is presented in table II.2.

Table II.2: Estimated O&M Costs for FY 1982-2005 Cleanup Plans

1994 dollars in millions

	Federal costs		States' costs		Responsible parties' costs		
Fiscal year of cleanup plan	**Groundwater**	**Non-groundwater**	**Groundwater**	**Non-groundwater**	**Groundwater**	**Non-groundwater**	**Total[a]**
1982-86	$119	0	$208	$241	$186	$29	$894
1987-92	1,102	$36	1,721	556	4,730	679	9,077
1993-2005 (sites added to NPL before 10/94)	2,168	254	2,924	1,015	7,596	875	15,068
1993-2005 (360 sites added to NPL 10/94 or later)	983	115	1,325	460	3,444	397	6,831
Total	**$4,371**	**$404**	**$6,178**	**$2,273**	**$15,956**	**$1,980**	
Grand total		**$4,776**		**$8,450**		**$17,936**	**$31,870**

Notes: The estimates for FY 1982 through 1986 and 1987 through 1992 are based on the O&M cost estimates contained in EPA's database of cleanup plans. The estimates for FY 1993 through 2005 are based on projections from our model.

Some totals do not add because of rounding.

[a]Figures in the total column include an estimated $708 million in O&M costs for cleanups funded jointly by the federal government and responsible parties.

Programmatic Changes That Would Affect Our Estimates

We reviewed past and current Superfund reauthorization proposals that could affect future O&M costs. The policy changes under consideration include the following:

- Changing the preference for treating highly contaminated waste to also consider the option of containing this waste. Because O&M costs are associated with containing waste, not with treating waste, O&M cost responsibilities will fluctuate depending on how often containment options are used.
- Changing the rules on the time frames for responsible parties' liability. The responsible parties are currently liable for cleaning up contamination that occurred before Superfund was passed in 1980. If this requirement is eliminated, the federal government's and the states' portions of O&M costs would increase.
- Changing the rules on responsible parties' liability. The responsible parties may currently be required to pay for all site cleanup, even if they did not contribute all the waste. Proposals for reauthorizing Superfund have called for the federal government to pay for those costs that cannot be

allocated to responsible parties, thus increasing the federal share of O&M costs.

- Changing the current O&M cost-share provisions between the federal government and the states. Recently proposed legislation would have implemented different cost-sharing provisions. Doing so would shift O&M cost responsibilities between the federal government and the states.
- Limiting the number of new sites added to the NPL. Proposals for reauthorizing Superfund have called for placing a cap on the sites added to the NPL in the future. If this proposal is adopted, the O&M costs for future NPL sites will be lower than the $7 billion we estimated.

Additional Examples of Monitoring O&M Activities

As stated in the report, monitoring O&M activities is important because it provides assurance that the cleanup remedies continue to protect human health and the environment. Both we, through our review of 17 case studies and our analyses of 43 5-year reviews, and EPA's Inspector General have identified cases in which covers were not maintained and groundwater sampling was not performed as required in the O&M plans. The following cases highlight these instances.

In our discussions with officials in EPA's Region IV, we identified a significant problem in monitoring O&M activities at the A.L. Taylor site (Valley of the Drums), located in Bullitt County, Kentucky. The state is now responsible for monitoring the waterproof cover used to contain chemical waste. However, local land-use controls to prevent activities that could potentially damage the cover have not been implemented. EPA and the state have had difficulty implementing land-use controls because the site is privately owned. Implementing land-use controls could have been critical at this site because the landowner was using the site as a junkyard for cars, potentially damaging the cover. After discussions with the state, however, the landowner agreed to remove the cars. Such a situation stresses the importance of continuous monitoring. Without it, EPA may not be aware of similar problems that may be occurring at other sites.

EPA's Inspector General, during a site visit, identified a significant problem in monitoring O&M activities at the Heleva Landfill site in Lehigh County, Pennsylvania. A pond adjacent to the landfill receives much of the site's surface water runoff. The pond overflowed onto the waterproof cover, damaging it. In addition, the project manager responsible for monitoring the site was unaware of the requirement to sample surface water, such as the pond, even though the cleanup plan required doing so at least once every 3 months. In fact, no sampling had been performed since the waterproof cover was installed in 1990. Animals had also damaged the cover by burrowing holes in it.

In our analysis of reports on EPA's 5-year reviews, we identified instances in which EPA had developed recommendations to address problems with maintaining covers. For example, at the Mowbray Engineering site in Greenville, Alabama, EPA recommended that the responsible party mow the cover regularly to prevent grass from growing too high. In addition, EPA recommended that the responsible party prevent trees from growing on top of the cover because the tree roots can potentially damage the cover. EPA also recommended that the fence surrounding the site be cleared of kudzu, a vine-like vegetation, so that the fence can be readily inspected.

We also identified some sites in which EPA developed recommendations to address problems with sampling the groundwater. In EPA's 5-year review of the Middletown Road Dump site in Annapolis, Maryland, EPA recommended that further groundwater sampling be conducted. Although EPA collected groundwater samples during its review, it could not conclude whether the groundwater was still a health threat. Therefore, additional sampling was recommended. In another example, for the Triangle Chemical Company Superfund site in Bridge City, Texas, EPA recommended that the state conduct groundwater sampling more frequently because contamination levels are still above acceptable levels.

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